A3 concl'd

colors reproduced at each rendering device have substantially the same appearance within the output colors attainable by the rendering devices.

Replace paragraph on page 12, lines 15-17, with the following paragraph:

A4

Another object of the present invention is to provide a system for controlling and distributing color reproduction which uses color instrumentation at rendering devices in calibrating the color of the devices and in subsequent verification of such calibration.

Replace paragraph on page 30, lines 12-26, with the following paragraph:

A5

Referring to Figure 4C, device independent color coordinates XYZ are input signals to display 17. Rendering employs the inverse of the operations used for imagical 14. The inverse of the calibration matrix M is called A^{-1} (to emphasize that we are considering numerically different matrices for the two devices) and is used to convert the XYZ input signals to linear device signals R'_{lin}, G'_{lin} and B'_{lin}. The linear device signals R'_{lin}, G'_{lin} and B'_{lin} are postconditioned using the inverse of the compensation function LUTs which define the non-linear relationship between applied signal and luminous output of display 17, a function which is defined and adjusted in a separate, empirical step of calibration. The output from the LUTs are gamma corrected signals $R^{1/\gamma}$, $G^{1/\gamma}$, and $B^{1/\gamma}$ representing the input to display 17. Note that there is no necessary relationship between the matrices A^{-1} and M in Figures 4B and 4C. Further, since the LUTs of Figures 4B and 4C may be used with various types of transformations in system 100, they are preferably represented by a separate data structure, within the software architecture, which may be combined like building blocks with other structures, such as 3X3 matrix, or multidimensional interpolation table, to form more complex data structures.

Replace paragraph on page 34, on line 32, to page 35, line 8, with the following paragraph:

A6

Preferably, the database maintains a FIFO history of color and summary statistics from the most recently measured forms. Because step 5 involves least squares error minimization, flagging of outlyers is preferred to reduce the influence of one bad reading. A decision on whether a current reading is legitimate is made by comparing CIE ΔE^*

values rather than the two spectra. The assembled list with flagged outlyers and standard deviation of each patch measurement is written to a calibration (cal.) data file in the local part of the VP, for later use in building the forward model.

A6 cont'd

Replace paragraph on page 39, line 25, to page 40, line 9, with the following paragraph:

A7

The data structure in Figure 9D accommodates the preconditioning of *j* address variables by *j* 1-dimensional transformations which may be implemented as look-up tables with or without interpolation 98. The preconditioning transformation may pass one or more of the *j* inputs Independent Variables (IVs) through to the multidimensional transform unaltered (identity transformation) or may apply a functional mapping such as a logarithmic conversion. The multidimensional transform 94 has *j* input variables and *i* outputs. The preferred implementation of the transformation is by interpolation in a sparse table of function values or by evaluation, in hardware, of a set of polynomials fitted to the tabular values (where fitting can be done with sufficient accuracy.) In Figure 9D, a 3-dimensional IV 93 is applied to the multidimensional transform 94. Multidimensional transform 94 consists of many smaller cuboids 95 whose corner points are the sparsely sampled values of the IV at which values of one (or more) of the dimensions of the dependent variable, DV, 96 are stored. The IV provides addresses and the DV contents. The subcuboid 95 is shown at the origin of the addressing scheme. Interpolation is used to estimate values of the DV occurring at values of the IV which are between corner points.

A7 concl'd

Replace paragraph on page 43, lines 15-23, with the following paragraph:

A8

Optimization methods can produce a useful result when no exact solution exists, as in the case when the desired color is unprintable by (or out of the gamut of) the device. The optimization is driven by an error function which is minimized, typically by using downhill, or gradient search procedures. In the case of Newton's Method, one of the colorant variables (in the four colorant case) must be fixed in order to find an exact solution; otherwise, there are infinitely many solutions. Usually, black is fixed. The

A8 concl'd algorithm for model inversion uses supporting search procedures in case the primary technique fails to converge to a solution.

Replace paragraph on page 54, lines 5-15, with the following paragraph:

A9 The concept can be extended by adding the property of smoothness described earlier. The operator is based on a continuously differentiable function such as sine on the interval 0 to $\pi/2$, which generally resembles the piecewise linear function described above in shape but has no slope discontinuity. A table (Table I) of values of the function is given below; the first column is a series of angles in radians, X, from 0 to $\pi/2$ (90°), the second, the sine of the angle, Y, and the third the fraction Y/X. If we set Y/X = (1 - cushion), we can control the "hardness" or abruptness of the gamut-mapping implemented by the operator stated below the table for the case of cushion ~= 0.1. For speed, the various evaluations implied may be implemented by interpolation in look-up tables. The operator described does not enable a purely proportional scaling (cushion = 1.) The latter is not generally desirable but is available to users through the gamut options of the GUI in Figure 21F. A9 cont'd

Replace paragraph on page 56, lines 23-29, with the following paragraph:

A10 Step 2) Build a model for converting C, M Blue and K (black or N) to color and omitting the colorant complementary to the "auxiliary," in this case, Yellow. Make a Forward Model Table and use the model to extend the original gamut descriptor prepared in (step 1). Do likewise for C, Y, Green and K and M, Y, Red and K. Note that the general rule is to add additional colorants one at a time, grouping each with the colorants which flank it in hue angle. Make FMTs for each new model for each auxiliary colorant and re-refine the Gamut Descriptor. Note, however, that the multiple models are used to refine only one GD. A10 finished

Insert on page 58, line 24, the following paragraph:

A11 After the above steps a-d, if additional non-neutral colorants are also to be added, processing branches to circled A in Figure 16A, otherwise the process for adding additional colorants ends.

Delete paragraph on page 59, lines 29-31.

Replace paragraph on page 61, lines 8-16, with the following paragraph:

Verification is a feature of system 100 used in virtual proofing, described above, and color quality control of production rendering devices. The reason for verification is that the use of system 100 for remote proofing and distributed control of color must engender confidence in users that a proof produced at one location looks substantially the same as one produced in another location, provided that the colors attainable by the devices are not very different. Once rendering devices are calibrated and such calibration is verified to each user, virtual proofing can be performed by the users at the rendering devices. In production control, such verification provides the user reports as to status of the color quality.

A12

Replace paragraph on page 63, lines 14-19, with the following paragraph:

Because, as was noted above, the variations in color need not be uniform throughout the gamut of the device, the data structure is segmented into clusters of contiguous cells in order to identify the most frequent colors in the various regions of the gamut. Thus, system 100 herein samples color errors throughout the image. The processing checks to make sure that the frequency it is reporting for a cluster of cells is a peak, not a slope from a neighboring cluster.

A13

Replace paragraph on page 64, lines 10-16, with the following paragraph:

For the simplest level of control, the inverse of the color errors may be used to prepare a conditioning transformation which then modifies the rendering transformation employed in making another proof. For more sophisticated, on-line control, the data are used to compute error gradients of the sort described earlier and used by optimization and error minimization algorithms. Results are fed to the control processor of a press or used to modify the rendering transform as a control mechanism for a press which does not use a press-plate bearing fixed information.

A14